

---

**Name of Organization:** University of Wisconsin - Madison

**Type of Organization:** College or University

**Contact Information:** Dr. Gerald R. Eykholt

Civil and Environmental Engineering

1415 Engineering Dr

Madison WI 53706

**Phone:** (608) 263 - 3137 **Extension:**

**Fax:** (608) 262 - 5199

**E-Mail:** eykholt@engr.wisc.edu

---

**Project Title:** PCB leachability of washed and biostabilized sediments

**Project Category:** Contaminated Sediments

**Rank by Organization (if applicable):** 0

**Total Funding Requested (\$):** 170,054 **Project Duration:** 2 Years

**Abstract:**

The management of PCB contaminated sediments is constrained by two primary conditions, public resistance to the landfill disposal option for untreated sediments from "hot-spots" and the high costs associated with treatment to lower, more acceptable levels. Research is needed to describe the leachability of "hot-spot" sediments relative to lesser contaminated media, and to evaluate whether mild treatments could be applied as part of the dredge-disposal process to greatly reduce leachability. The proposed work would be used to gather basic information on leachability of PCB contaminated sediments, to develop and test a new treatment option, as well as to develop preliminary designs and engineering assessments. The investigators will work in close association with Dr. Steve Laszeski of Foth & van Dyke (Green Bay, WI), who will coordinate meetings with sediment remediation experts. The research team and experts will review process performance, develop preliminary designs, and costs and engineering assessments. The researchers are experienced in sediment remediation and biodegradation.

---

**Geographic Areas Affected by the Project**

**States:**

<input checked="" type="checkbox"/> Illinois	<input checked="" type="checkbox"/> New York
<input checked="" type="checkbox"/> Indiana	<input checked="" type="checkbox"/> Pennsylvania
<input checked="" type="checkbox"/> Michigan	<input checked="" type="checkbox"/> Wisconsin
<input checked="" type="checkbox"/> Minnesota	<input checked="" type="checkbox"/> Ohio

**Lakes:**

<input type="checkbox"/> Superior	<input type="checkbox"/> Erie
<input type="checkbox"/> Huron	<input type="checkbox"/> Ontario
<input type="checkbox"/> Michigan	<input checked="" type="checkbox"/> All Lakes

**Geographic Initiatives:**

☐ Greater Chicago   ☐ NE Ohio   ☐ NW Indiana   ☐ SE Michigan   ☐ Lake St. Clair

**Primary Affected Area of Concern:** Fox River/Green Bay, WI

**Other Affected Areas of Concern:** harbors, rivers with PCB-contaminated sediments

---

***For Habitat Projects Only:***

**Primary Affected Biodiversity Investment Area:**

**Other Affected Biodiversity Investment Areas:**

---

**Problem Statement:**

The management of contaminated sediments is constrained by two primary conditions, public resistance to the landfill disposal option for untreated sediments from "hot-spots" and the high costs for treatment to lower, more acceptable levels. The municipal landfill option is available in Wisconsin for PCB-contaminated sediments that exceed the TSCA level of 50 mg/kg. However, public opposition and a lack of PCB landfill leachability data forced a decision to send recently dredged sediments from the Fox River to a TSCA landfill in Michigan, at considerable costs. Applied research is needed to identify cost-effective treatment strategies and to better characterize the leachability behavior for these "hot spot" sediments compared with other dredged sediments with lower PCB concentrations.

**Proposed Work Outcome:**

As the landfill disposal option is a key element for the management of dredged, contaminated sediments from the Fox River, harbors of the Great Lakes, and other sites, the objectives of this research are to develop a new sediment treatment strategy and methods for testing leachability, in order to:

- remove the readily extracted PCB fractions from the dredged sediments
- concentrate and isolate the extracted PCBs for safe handling
- remove residual leachability through biostabilization
- characterize and compare the dynamics and extent of leachability of treated and untreated sediments

The strategy is to identify and test extraction methods that could be coupled efficiently with modern dewatering and water treatment methods targeted for the dredge-disposal option, and biostabilization methods that operate well within the landfill setting. Project results will be evaluated with experienced remediation contractors in order to develop practical designs and cost estimates for field implementation. Experimental methods and engineering assessments will also be discussed with officials from the Wisconsin Dept. of Natural Resources and EPA-GLNPO. These efforts will support GLNPO interests in bench/pilot studies to support "on the ground sediment remediation".

**APPROACH** The 24-month project will develop and demonstrate a treatment scheme for PCB-contaminated sediments. The scheme includes surfactant extraction (washing) of available PCBs from dredged sediments and biostabilization of the treated sediments to remove residual leachability. In practice, the scheme could be implemented as part of a dredge-disposal remediation operation. Surfactant extraction would be implemented during sediment processing and dewatering operations, and biostabilization would operate within the landfill. In this context, biostabilization would be effective whether or not the residual PCBs were degraded, since the goal is to biodegrade residual surfactants in order to greatly reduce leachability. While this research is focused on bench/pilot testing, the project will include an engineering

---

assessment and preliminary design for full-scale processes.

The effectiveness of the treatment scheme will be measured by comparing PCB leachability of treated and untreated PCB-contaminated sediments. For all treatments, leachability will be described by the extent and rates of PCB extraction and adsorption to model sorbents in batch tests. We are particularly interested in leachability comparisons between the cases of untreated, non-TSCA sediments and treated, TSCA sediments. We will report on the level of PCB extraction and leachability of the residual sediments after no treatment, washing alone, biostabilization alone, and the integration of the processes. An engineering assessments for costs, scales of operation, water treatment requirements, and materials handling will also be developed during the study.

**Study sediments:** A set of well characterized, PCB-contaminated sediments from the Lower Fox River and from an industrial partner will be used. The PCB extraction dynamics of these sediments will be evaluated by batch desorption experiments with Tenax TA resin to accumulate the PCBs. The extraction dynamics will be modeled. Two or more sediments exhibiting a significant portion of readily extracted PCBs will be selected for further study with surfactant extraction. The initial PCB concentration should be below 50 mg/kg for one sediment (A) and above 50 mg/kg for the second sediment (B). The contaminant distribution with particle size will be described for these study sediments.

**Surfactants and extractive washing:** Four commercial surfactants known to solubilize PCBs will be screened for their ability to extract PCBs from the study sediment B, and for factors such as biodegradation potential, acceptable sorptive losses and costs. Surfactant costs should be below \$10/ton of sediment treated in order to ensure cost-effectiveness, should not sorb to a high degree to the sediments, and preliminary data on rates of surfactant biodegradation need to be acceptable. Some alcohol polyethoxylate surfactants meet the above criteria, as separate studies have shown favorable washing potential, relatively low sorption losses, moderate costs, and good biodegradation potential. Washing will be performed in end-over-end mixed batch tests, with multiple wash stages. Sorbents will be used to accumulate PCBs, keeping the free solution concentration low while maintaining surfactant concentrations in the bulk liquid. The extraction dynamics of different particle size fractions will be measured and a model will be used to better describe the overall extraction dynamics of the mixture. This information may be critical for engineering highly effective separations at scale. In addition, solid-liquid separation characteristics of treated sediments will be compared with untreated sediments.

**Biostabilization:** It is uncertain at this point whether the microbial activity on native sediments is adequate for effective degradation of surfactants. So, the study will include an evaluation of different assays, with and without amendments. The biodegradation potential will be evaluated by assays with and without small amounts of activated sludge or acclimated anaerobic digester sludge from a wastewater treatment plant. The success or failure of biostabilization will be judged based on changes in PCB leachability of the treated sediments relative to untreated sediments. Through a set of control tests, we hope to distinguish the effects on leachability from leachate, residues in untreated sediments, amendments, and residual surfactants.

**Engineering Assessment:** Following the collection and reporting of the bench-scale data an engineering design team, with experience in sediment remediation work, will meet and integrate the project findings into the dredge-treatment-disposal process. This team will develop a construction level design to evaluate costs and the feasibility of implementing the process to treat PCB-contaminated sediments in Great Lakes Areas of Concern.

**OUTCOME:** This research should increase the cost-effectiveness and reduce the levels of uncertainty associated with the remediation of "hot spot" sediments. A greater range of treatment options will be available for the general, dredge-disposal strategy. Although municipal landfill leachability issues will not be tested directly, this research will provide much needed leachability testing methods and data on PCB-contaminated sediments. The methods and results obtained by the research should lead to effective remediation strategies that also meet a wider level of public approval.

---

**Project Milestones:****Dates:**

Project Start	07/2000
complete first stage of washing eval.	01/2001
biostabilization on untreated sediments	02/2001
leachability assessed, design & review	07/2001
washing dynamics fully assessed	03/2002
biostabilization studies complete	04/2002
engineering assessments complete	05/2002
Project End	06/2002

---

☐ Project Addresses Environmental Justice

**If So, Description of How:**

☒ Project Addresses Education/Outreach

**If So, Description of How:**

One major factor in gaining public acceptance in plans for sediment disposal is the assurance that "hot-spot" sediments will pose no greater risks to human health or the environment than lesser contaminated materials. Another factor in gaining public acceptance is providing evidence that a range of treatment options have been evaluated by process engineers. This project aims to provide a better basis for technical communication and to provide more remediation options that remain cost-effective. So, in addition to providing much needed technical information on the sediments, a key project goal is to report the methods and results in a format that increases public awareness and involvement, and reduces the uncertainty and doubts about practical sediment management strategies.

---

**Project Budget:**

	<b>Federal Share Requested (\$)</b>	<b>Applicant's Share (\$)</b>
<b>Personnel:</b>	65,762	6,941
<b>Fringe:</b>	13,631	2,256
<b>Travel:</b>	2,200	0
<b>Equipment:</b>	0	0
<b>Supplies:</b>	19,000	0
<b>Contracts:</b>	15,000	0
<b>Construction:</b>	0	0
<b>Other:</b>	2,500	0
<b>Total Direct Costs:</b>	118,093	9,197
<b>Indirect Costs:</b>	51,961	4,047
<b>Total:</b>	170,054	13,244
<b>Projected Income:</b>	0	0

---

**Funding by Other Organizations (Names, Amounts, Description of Commitments):**

The University of Wisconsin, Dept. of Civil and Environmental Engineering, will cost-share at least 5% of total project costs in the form of the PI salaries during the normal academic year (releasing a portion of academic duties to support the project). In addition, the Environmental Engineering Laboratory may purchase a GC/MS. If purchased, this instrument will be used by investigators without incurring equipment purchase costs to the federal portion of the project budget.

---

**Description of Collaboration/Community Based Support:**

Dr. Steve Laszewski of Foth & Van Dyke (Green Bay, WI) will serve as a major consultant to the project. He will coordinate meetings for the engineering assessments for the project. His experiences with the Deposit N demonstration in the Lower Fox River

Following the collection and reporting of the bench-scale data an engineering design team, with experience in sediment remediation work, will meet and integrate the project findings into the dredge-treatment-disposal process. This team will develop a construction level design to evaluate costs and the feasibility of implementing the process to treat PCB-contaminated sediments in Great Lakes Areas of Concern.